

IMD report on the status of current and future satellite systems

ACTION (and/or recommendation) PROPOSED:

i) NIL

Executive Summary:

At present, two INSAT Meteorological satellites are in operation i.e. INSAT-3D and INSAT-3DR. INSAT- 3D is India's advanced weather satellite located at 82°E and was launched on 26 July 2013 and INSAT-3DR was launched on 8 September 2016. They are dedicated meteorological satellites and carries four payloads: imager (six channels), sounder (19 channels), Data Relay Transponder (DRT) and satellite aided search and rescue (SAS & R).

Imager payloads of INSAT-3D & INSAT-3DR are used in a staggered mode to achieve 15-minute temporal resolution for getting cloud imaging. INSAT-3D Sounder reached its end of life in September 2020, since then INSAT-3DR sounder is being used to collect data on hourly basis of Indian land region (Sector-A) twenty times and Indian Ocean Region (Sector-B) four times on hourly basis.

IMD has established the Multi-Mission Meteorological Data Receiving and Processing System (MMDRPS) for INSAT-3D, INSAT-3DR and INSAT-3DS satellites. The system has three dedicated earth station and data receiving system. Each Earth station is receiving the data in redundant mode from each payload (Imager, Sounder and DRT) and it has dedicated Raw data archival storage facility. MMDRPS have very high-end processing system which cut down the processing time from 15 minutes to 7 minutes and has provision to update calibration coefficient in operational chain using Cal/ Val site & GISCS data. System is capable to process RAPID scan data of INSAT-3DR Imager payload conducted during Extreme weather events. MMDRPS have storage capacity of the order of 2.0/2.0PB (Main/ Mirror) & 324TB SSD which will facilitate online sharing of processed data for all Indian meteorological satellites to the registered users as per IMD data policy. All available past satellite datasets starting from 1983 will be kept in online mode in due course of time, till now Kalpana-1 satellite data wef 2014 to 2017 has been archived. The MMDRPS system has been declared operational on 12th November 2020 and being used to Receive & process the INSAT-3D and INSAT-3DR satellites data on a operational basis.

Data exchange between IMD and other national and international agencies takes place on a real time basis. A dedicated National Knowledge Network (NKN) has been established by IMD with ISRO and also with NCMRWF for real time transfer of INSAT 3D radiance data along with LST, winds and GNSS-IPWV data to be assimilate in the NWP models. Insat-3D & 3DR wind products are being disseminated in Bufr format through Global Telecommunication system (GTS) network for international agencies in real time basis. The MMDRPS has dedicated Web based Data supply System (DSS) in redundant mode to cater web-based data dissemination requirements in near realtime basis to various users (both local and remote global) based on data dissemination policy of IMD.

Web-DDS has user registration/authentication mechanism based on data dissemination policy of IMD, Metadata generation for data search; Data search & order with a facility to handle band, format, Area & temporal selection options ; Standing order ; User Administration (Add, Edit, Delete) ; User Order processing system; Dataorder workflow monitoring; Report generation & Data download history based on satellite/sensor & duration; Satellite, sensor parameters, Data products & metadata management (Add, Edit, Delete), The web based-DSS is in advanced stage of implementation and potential users will be informed.

IMD has two dedicated webpages (<http://satellite.imd.gov.in/insat.htm>: <http://satmet.imd.gov.in/insat3d.htm>) and RAPID. The webpages are being updated every 15 minutes. These Web sites now being assessed using user Name “guest” and password may be obtained through email from **virendra61.singh@imd.gov.in**.

In addition, RAPID Beta Version is also in the final stage of implementation which will have the provision to visualize the NWP, radar, in-situ observational data on a real time basis overlayed on satellite data with georeferencing information & compatible to mobile users.

INSAT-3DR Imager payload is used to conduct rapid scans during four Tropical Cyclones namely: SuCS Amphan, SCS Nisarga, VSCS Gati and CS Burevi during May 2020 to April 2021. Each Rapid scan cover up 3 degrees in N-S direction (6 Blocks/240 scan lines) in 4.5 minutes. Rapid scan data has been used to track these cyclones in real time basis. The processed data is being disseminated on a dedicated webpage (http://satellite.imd.gov.in/rapid/rapid_scan.htm).

As per the demand of forecasters several new Geophysical products (Imager /Sounder) are being generated operationally by MMDRPS at pixel level with range of frequencies (half hourly, daily, weekly, monthly, 15-day composite). These products are Net radiation, Improved INSAT Multispectral Rainfall, Land Surface Albedo (land), Short Wave Radiation over Ocean, Total Precipitable Water over Ocean, Potential Evapotranspiration over land, Actual Evapotranspiration and Cloud Top Pressure, Effective Emissivity, Cloud Top Temperature respectively. The Agromet Products (PE and AE) accuracy has been improved significantly using IMD high resolution WRF Forecast and Sevir NDVI Data being received through EMETCAST system at IMD. SST derivation using 1- ID Var technique has been implemented.

Recently, new Advanced Dvorak Techniques (ADT) is implemented in MMDRPS using INSAT 3D & 3DR imager data and tested on an experimental basis of two cyclones- Amphan, Nisarga. 10 Day sliding composite Snow maps and snow anomaly maps are generated operationally in public domain for mountain regions to identify the fresh snow, melting snow area and potential vulnerability area of landslide/flash flood in mountain regions.

To monitor Ground based real time Integrated Precipitable Water Vapour (IPWV), IMD installed 25 GNSS all over India as Indian Global Navigation and Satellite System (GNSS) which is operationally used in day to day weather forecasting and monitoring the convective development. The real time GNSS IPWV estimated from IMD network is available in the public domain as <http://gnss.imd.gov.in/TrimblePivotWeb/>. In this web analysis, tools are available to plot real time, daily, weekly and monthly data with maximum and minimum values.

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1. INTRODUCTION

India Meteorological Department (IMD) is an operational National Meteorological services of India to collect meteorological observations and to provide current and future meteorological information for optimum operation of weather sensitive activities like agriculture, irrigation, shipping, aviation, tourism, offshore oil explorations, etc and to issue warnings for severe weather phenomena like tropical cyclones, nor-westerns, dust storms, heavy rainfall and snowfall, cold and heat waves, fog which causes destruction to life and property. To support meteorological space-based observations of India, Indian Space Research Organization (ISRO) developed and launched the geostationary and polar orbiting meteorological satellites based on IMD's requirements. At present, two INSAT Meteorological satellites are in operation i.e. INSAT-3D and INSAT-3DR which are located at 82°E and 74°E respectively. In the past year, no new INSAT meteorological Satellite was launched.

2. CURRENT SATELLITE SYSTEMS

2.1 Status of GEO

The Indian National Satellite (INSAT) programme a series of multipurpose geo-stationary satellites by ISRO was started in 1982. INSAT is one of the largest domestic communication satellite systems in Asia-Pacific region with nine operational communication satellites placed in Geo-stationary orbit. IMD had established a ground receiving processing system for INSAT series satellite in 1983. INSAT-1 series of satellites were Multipurpose satellites, having a meteorological payload, two channels Very High-Resolution Radiometer (VHRR) for imaging the Earth in Visible (0.55-0.75 μm) and Infra-Red (10.5-12.5 μm) channels having resolution of 2.75 X 2.75 kms in visible and 11 x 11 kms in IR channel. After that, INSAT 2 series and INSAT 3 series multipurpose/dedicated meteorological satellites were launched.

Satellite	Sensor	1980-1990	1990-2000	2000-2010	2010-2020
INSAT-1A (1982)	VHRR (VIS,TIR)	 OLR, CMV, Rain, Cloud Image			
INSAT-1B (1983)	VHRR (VIS,TIR)		OLR, CMV, Rain, Cloud Image		
INSAT-1C (1988)	VHRR (VIS,TIR)		 OLR, CMV, Rain, Cloud Image		
INSAT-1D (1990)	VHRR (VIS,TIR)			OLR, CMV, Rain, Cloud Image	
INSAT-2A (1992)	VHRR (VIS,TIR)			OLR, CMV, Rain, Cloud Image	
INSAT-2B (1993)	VHRR (VIS,TIR)			OLR, CMV, Rain, Cloud Image	
INSAT-2E (1999)	VHRR (VIS,WV,TIR) CCD (VIS,NIR,SWIR)	OLR, AMV, UTH, Rain, Cloud Image			
Kalpana-1 (2002)	VHRR (VIS,WV,TIR)	OLR, AMV, UTH, Rain, Cloud Image			
INSAT-3A (2003)	VHRR (VIS,WV,TIR) CCD (VIS,NIR,SWIR)	OLR, AMV, UTH, Rain, Cloud Image			

The current operational INSAT 3 series constellation consists of two satellites, namely INSAT 3D and INSAT 3DR. They are positioned at 82°E and 74° E respectively. INSAT-3D was launched on 26th July, 2013 and INSAT-3DR was launched on 08th September 2016. INSAT-3D & INSAT-3DR carries 6 channel imager for imaging the earth in visible (0.55-0.75um), SWIR (1.55- 1.70um) of resolution 1KmX1 Km, MIR (3.80-4.00um),TIR-1 (10.30-11.30um),TIR2(11.50-12.50um) of resolution 4KmX4Km and WV (6.50-7.10um) of resolution 8KmX 8Km. and 19 channels sounder consisting of 7 channels of LWIR (14.71-12.02um), 5 channels of MWIR (11.03-6.51um), 6 channels of SWIR (4.572-3.74um) and one channel of visible (0.695um) each of resolution 10X10 Km scan the atmosphere for derivation of profiles, Data Relay Transponder (DRT) and satellite aided search and rescue.

Sector	Satellites	Location	Launch Date	Status	Instrument Capacity
Indian Ocean (0°-160°E)	INSAT-3D	82°E	26 th July, 2013	Primary operation for full disk scan	Imager, Sounder, DRT, SAS&R
Indian Ocean (-7°E-153°E)	INSAT-3DR	74°E	08 th September, 2016	Primary operation for full disk scan and RAPID scan during severe weather events	Imager, Sounder, DRT, SAS & R

2.2 Mission objectives, payloads

Mission objectives:

- To monitor earth's surface, carryout oceanic observations and its environment in various spectral channels of meteorological importance.
- To provide the vertical profile of temperature and humidity parameters of the atmosphere.
- To provide the data collection and data dissemination capabilities from the Data Collection platforms (DCPs).
- To provide the satellite aided search and rescue services

Imager

The Imager is an improved design of VHRR/2 (Very High-Resolution Radiometer) heritage instrument flown on the Kalpana-1 and INSAT-3A missions. The instrument features 6 spectral bands (against the 3 bands in previous versions) offering an improved 1 km resolution in the visible band for the monitoring of mesoscale phenomena and severe local storms. The two new SWIR and MWIR bands with a resolution of 1 km and 4 km, respectively, will enable better land-cloud discrimination and detection of surface features like snow. One more significant improvement is the split-band TIR channel with two separate windows in 10.2-11.2 and 11.5-12.5 μm regions with a 4 km resolution. This new element will enable the extraction of sea surface temperature over the Indian region with a far greater accuracy since the dual-window algorithm can be applied to eliminate the atmospheric attenuation effects. The 1 km resolution of the visible channel and 4 km resolution of the thermal IR channels will indirectly improve the accuracy of the derived products like outgoing longwave radiation and cloud motion vectors.

Sounder:

The Sounder is a first-time radiometer instrument of the geostationary INSAT series designed and developed at ISRO. The overall objective is to measure the temperature and humidity profiles (vertical distributions) to obtain a three-dimensional representation of the atmosphere. The instrument requirements call for soundings at 10 km ground resolution every 3 hours for a full frame scan. This enables the derivation of vertical profiles of temperature and humidity. These vertical profiles can then be used to derive various atmospheric stability indices and other parameters such as atmospheric water vapor content and total column ozone amount.

DRT (Data Relay Transponder):

The DRT receives globally meteorological, hydrological and oceanographic data from automatic DCPs such as AWS/ARG, AMS (Data Collection Platforms) in the ground segment and relays back to downlink in extended C -band. For extreme weather- related disasters such as a cyclone, floods and drought, real time observations of the associated parameters with appropriate network density are very important. Satellite enabled DCPs provide a unique solution for gathering meteorological data from all over the country including remote and inaccessible places.

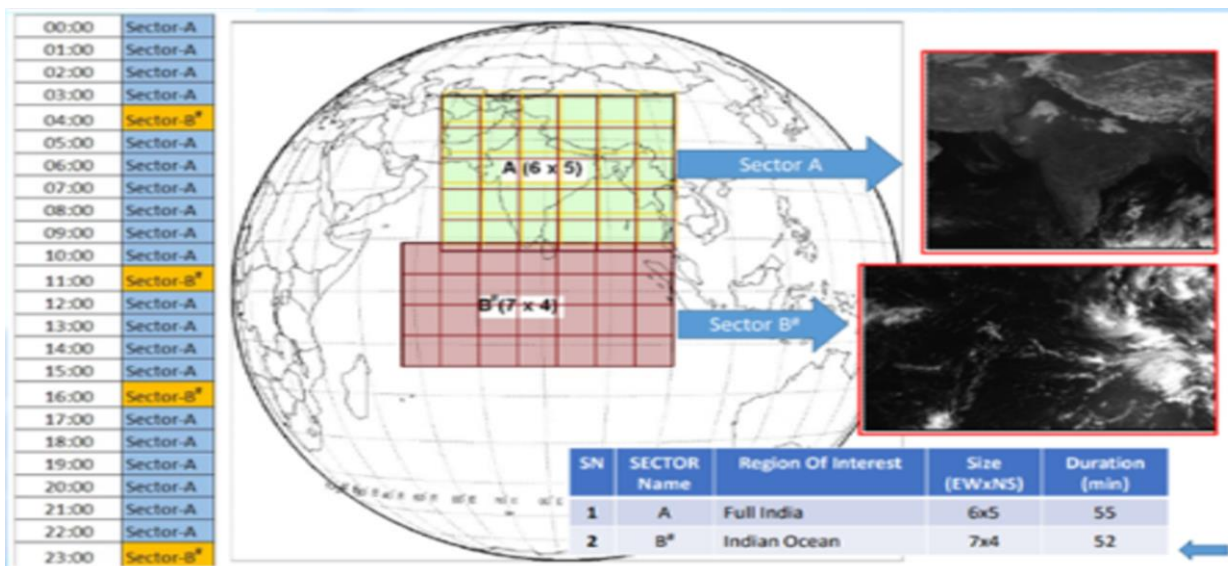
SAS&R (Satellite Aided Search & Rescue):

The SAS&R payload operates at 406 MHz. The objective of SAS&R is to relay a distress signal / alert detection from the beacon transmitters for search and rescue purposes with

global receive coverage in UHF band. The downlink operates in extended C-band. The data are transmitted to INMCC (Indian Mission Control Center), located at ISTRAC (ISRO Telemetry, Tracking and Command Network), Bangalore.

Operational scenario of INSAT -3D/3DR

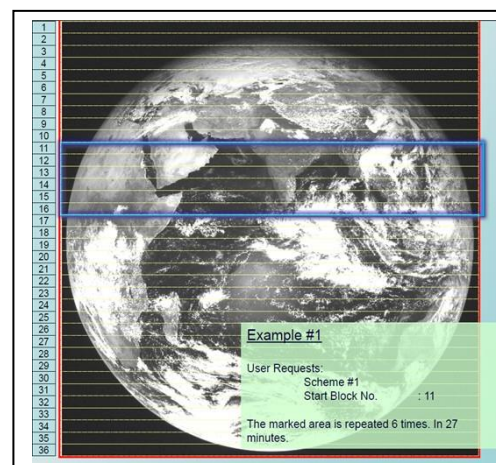
INSAT Series	Temporal Resolution
3D -Imager (6 Channel)	½ hourly (xx00 & xx30 UTC)
3D -Sounder (19 Channel)	Reached end of life in September 2020.
3DR -Imager (6 Channel)	½ hourly (xx15 & xx45 UTC)
3DR -Sounder (19 Channel)	Hourly (20 times Region-A & 4 times Region-B) since October 2020



Rapid Scan Strategy:

Rapid Scan is performed through INSAT 3DR Imager in case of severe weather events following a standard operating procedure using following information. Normal mode scan area has been divided into 36 Blocks in North-South directions such that:

- Each block covers 0.50 in N-S direction.
- No of Scan lines for Each block: 40
- Time required to scan each block: 45 sec
- Extent of coverage: 6 Blocks (3° coverage in 240 lines)
- No. of repetitions: 6
- Time required: 27 minutes
- (6 blocks with 6 repetitions)



3. Ground segment

IMD had established a Multi-Mission Meteorological Data Receiving & Processing System (MMDRPS) for INSAT-3D, INSAT-3DR and INSAT-3DS satellites and is on an operational basis since 01st October 2019. The MMDRPS system has been declared operational on 12th November 2020 and being used to Receive & process the INSAT-3D and INSAT-3DR satellites data.

The ground system comprises of three dedicated Earth stations under the MMDRPS [Multi-Mission Meteorological Data Reception and Processing System] Project, which have the capability to receive the data from INSAT-3D, INSAT-3DR and upcoming INSAT-3DS satellites on near real time basis.

The main components of Earth station are

- i) RF Segment- Each Earth station is having a receiving chain of following equipment / instrument- 7.5m diameter Cassegrain type Antenna, Antenna control unit, outdoor unit, feed, two LNA (Main & redundant) & C-band active type RF splitter, Beacon tracking receiver.
- ii) Individual earth station capable to receive the data in redundant mode from each payload (Imager, Sounder and DRT).

The salient features of MMDRPS processing components are:

- MMDRPS have very high-end processing system which cut down the processing time from 15 minutes to 7 minutes.
- Cal/ Val site data / GISCS calibration coefficient to be used in operational chain.
- System is capable to process RAPID scan data of INSAT-3DR Imager payload conducted during Extreme weather events.
- MMDRPS have storage capacity of the order of 2.0/2.0PB (Main/ Mirror) & 324TB SSD which will facilitate online sharing of processed data for all Indian meteorological satellites to the registered users as per IMD data policy.
- Image processing software for INSAT-3D/3DR and upcoming INSAT-3DS satellite data and convert them into various standard data formats like ASCII, binary, NetCDF, Hierarchical Data Format (HDF5).
- All available past satellite datasets starting from 1983 will be kept in online mode in due course of time.

Multi-Mission Meteorological Data Receiving and Processing system (MMDRPS) Declared operational on 12th November 2020.

Earth Station

Dedicated Earth station of INSAT-3D/3DR/3DS



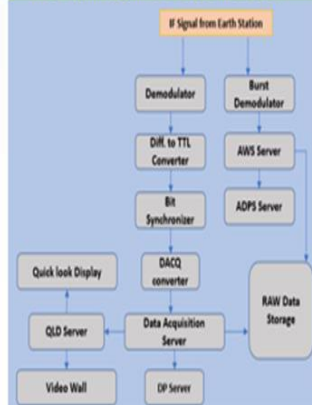
- Individual earth station is capable to receive the data in redundant mode from each payload (Imager, Sounder and DRT).
- Real Time Signal Monitoring.
- Auto tracking of satellite.
- Status of Signal locking.
- Time Synchronization using GPS receiver.
- Online BER measurement
- Frame synchronization
- Frame and Format verification



Data Reception & QLD System

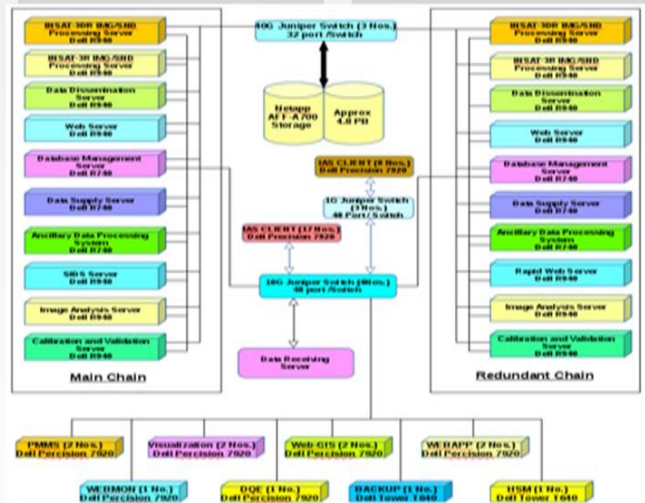


- Each DR system receives the base band serial data stream of the satellite sensor from the corresponding RF-IF segment.
- DR systems are configured on high end Windows Server-2012 based platform using Data Reception (DR) software Suits.
- Real time Data Acquisition and CIU control and Ingest with online status updates, with Telemetry logger.
- Data transfer to DP System for subsequent Processing and online processing of raw data stream for band separation, telemetry stripping for Band wise Quick Look Display (partially processed) on Console and networked display workstations.
- Independent P-QLD, TM processing. Ingest systems.
- Dedicated receiving and processing system for AWS/ARG/AMS of IMD and ISRO networks.



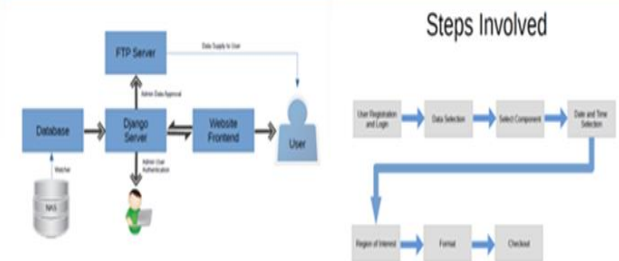
Data Processing, Storage System & IAS client System

- Availability of Image processing software for INSAT-3D/3DR and upcoming INSAT-3DS satellite data and convert them to the various standard formats like ASCII, binary, NetCDF, Hierarchical Data Format (HDF5).
- MMDRPS have very high end processing system which cut down the processing time from 15 minutes to 7 minutes.
- Call Val site data / GISCS calibration coefficient to be used in operational chain.
- System is capable to process RAPID scan data of INSAT-3DR Imager payload conducted during Extreme weather events.
- MMDRPS have storage capacity of the order of 2.0/2.0PB (Main/ Mirror) & 324TB SSD which will facilitate online sharing of processed data for all Indian meteorological satellites to the registered users as per IMD data policy.
- All available past satellite datasets starting from 1983 will be kept in online mode in due course of time.



Data Supply System

- Data Supply Server (DSS) is an online software package which will cater to the supply of INSAT-series satellites' data to the users through a dedicated web portal.
- Data will be supplied to the users as per IMD data policy guidelines.

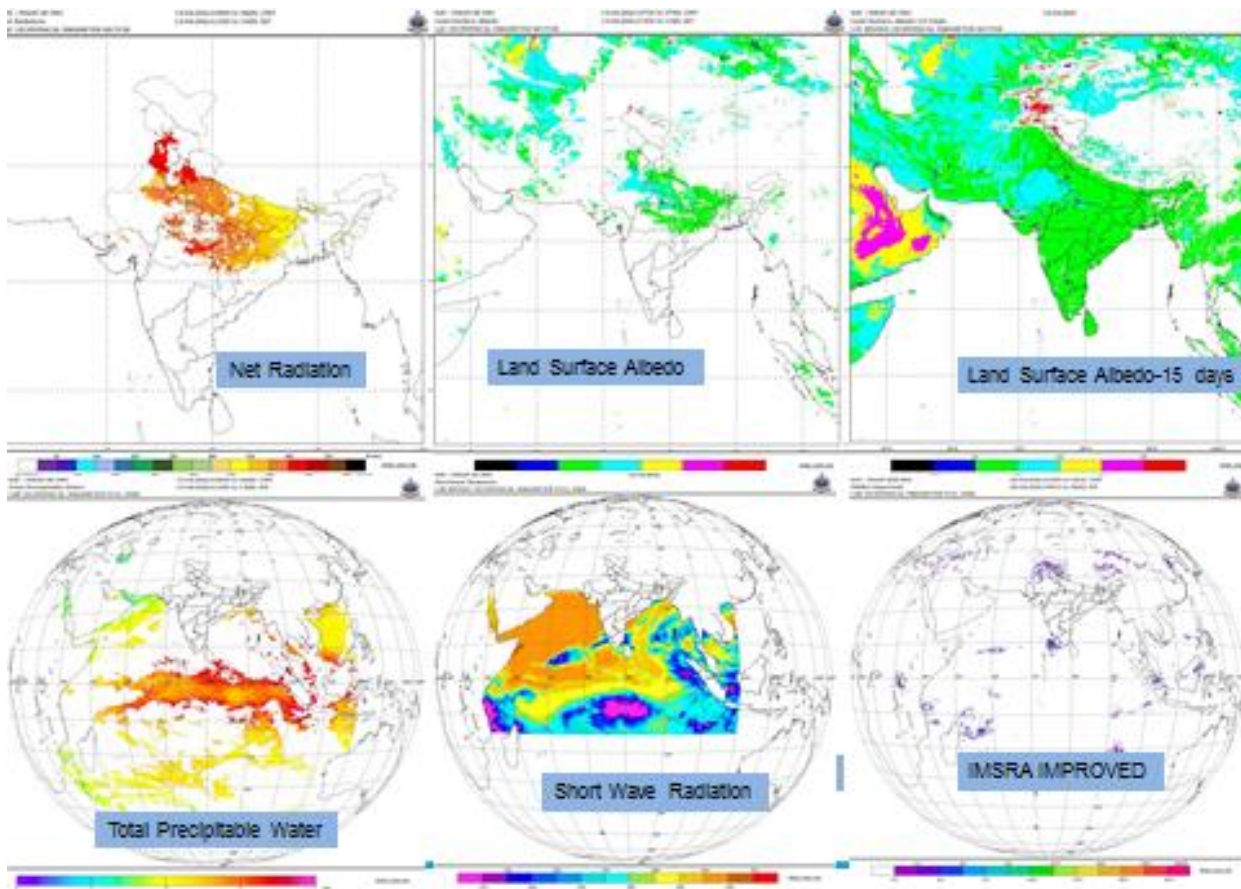


4 PRODUCTS AND SERVICES

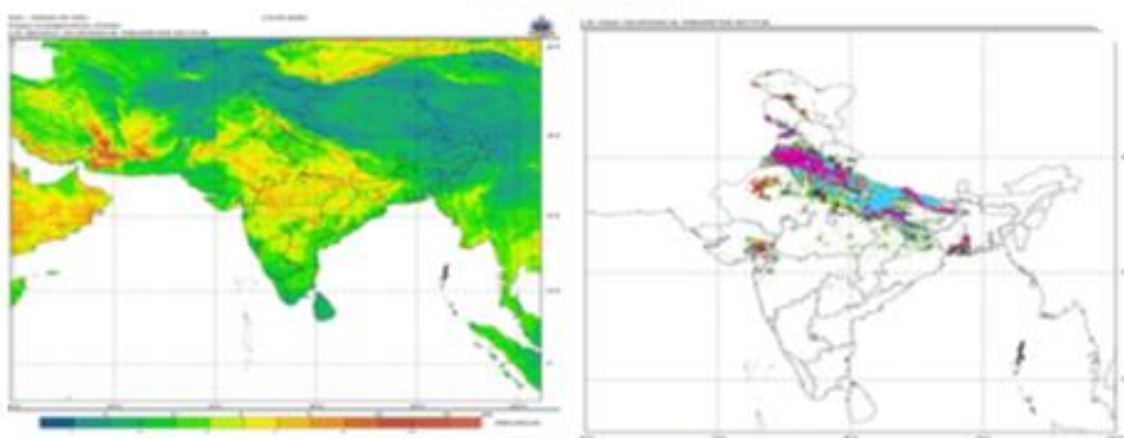
4.1 New Imager Products:

As per the demand of forecasters several new Geophysical products (Imager /Sounder) are being generated operationally by MMDRPS at pixel level with range of frequencies (half hourly, daily, weekly, monthly, 15-day composite). These products are Net radiation, Improved INSAT Multispectral Rainfall, Land Surface Albedo (land), Short Wave Radiation over Ocean, Total Precipitable Water over Ocean, Potential Evapotranspiration over land, Actual Evapotranspiration and Cloud Top Pressure, Effective Emissivity, Cloud Top Temperature respectively. The Agromet Products (PE and AE) accuracy has been improved significantly using IMD high resolution WRF Forecast and Sevir NDVI Data being received through EMETCAST system at IMD.

Product	Temporal Resolution	Horizontal Resolution	Format	Domain	Unit	Remarks
Potential Evapotranspiration (PET)	Daily & 4/3 days	Per Pixel	HDF/JPEG	500E- 1050E 50S- 410N	mm	Potential Evapotranspiration (PET) over land
Actual Evapotranspiration	Daily	Per Pixel	HDF/JPEG	600E- 1000E 50N- 400N	mm/day	Actual Evapotranspiration
Net Radiation	Half hourly	Per Pixel	HDF/JPEG	600E- 1000E 50N- 400N	Watt/m ²	Over Land
IMSRA (Improved)	Half hourly, Daily, Weekly, Monthly	Per Pixel	HDF/JPEG	Globe	mm/hr (mm-Daily, Weekly, Monthly)	IMSRA (Land and Ocean)
Land surface Albedo	Half hourly during Sunlight, Daily & 15 day composite	Per Pixel	HDF/JPEG	600E- 1000E 50N- 400N	Unit -less	Over land
Short Wave Radiation	Half hourly during Sunlight, Daily	Per Pixel	HDF/JPEG	400E- 1100E 150S- 250N	Watt/m ²	Over Ocean
Total Precipitable Water Vapour	Half hourly	Per Pixel	HDF/JPEG	Globe	cm	Over Ocean



Agromet Products with improved accuracy and resolution using IMD WRF Forecast and Seviri NDVI Data

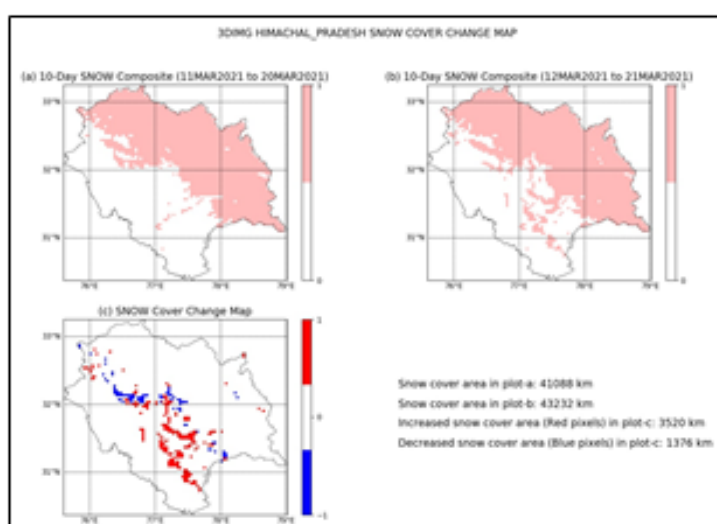


We acknowledge the use of NDVI Data from Metosat-8 received through EUMETCAST system at IMD

State wise Daily Snow Variation Map for Mountain Region:

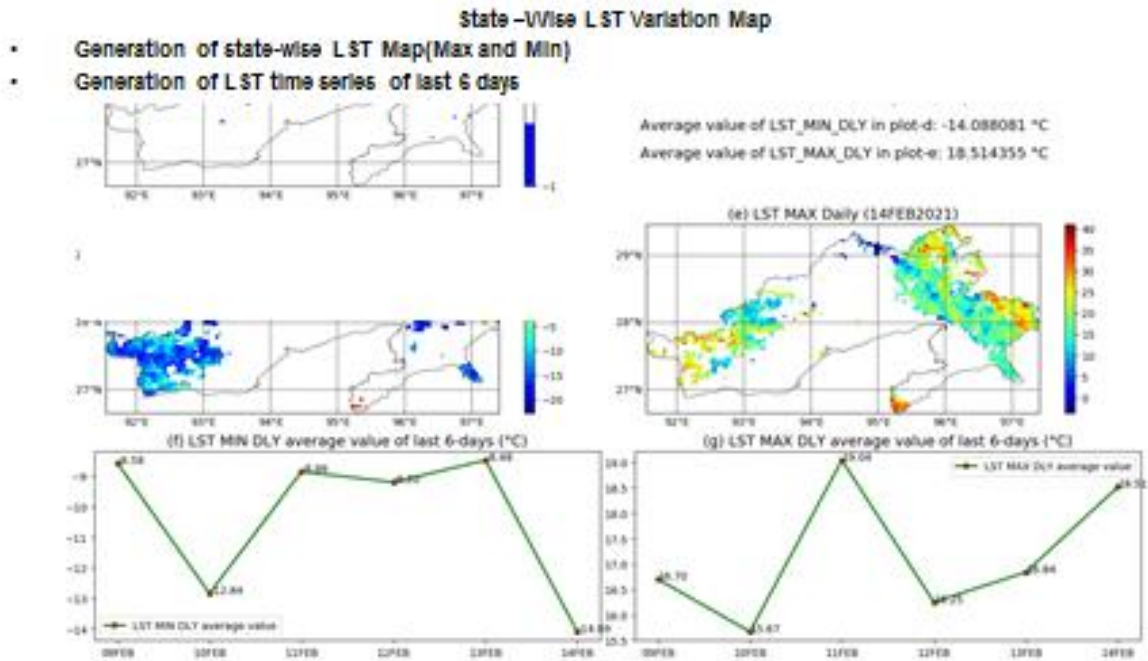
Using ten (10) Day sliding composite Snow maps, the snow anomaly maps are generated operationally in public domain for mountain regions to identify the fresh snow, melting snow area and potential vulnerability area of landslide/flash flood in mountain regions. On the same line LST state wise LST plot with six days state average LST of mountain states also generated.

Generation of 10 Day sliding composite Snow maps and snow anomaly maps for mountain regions



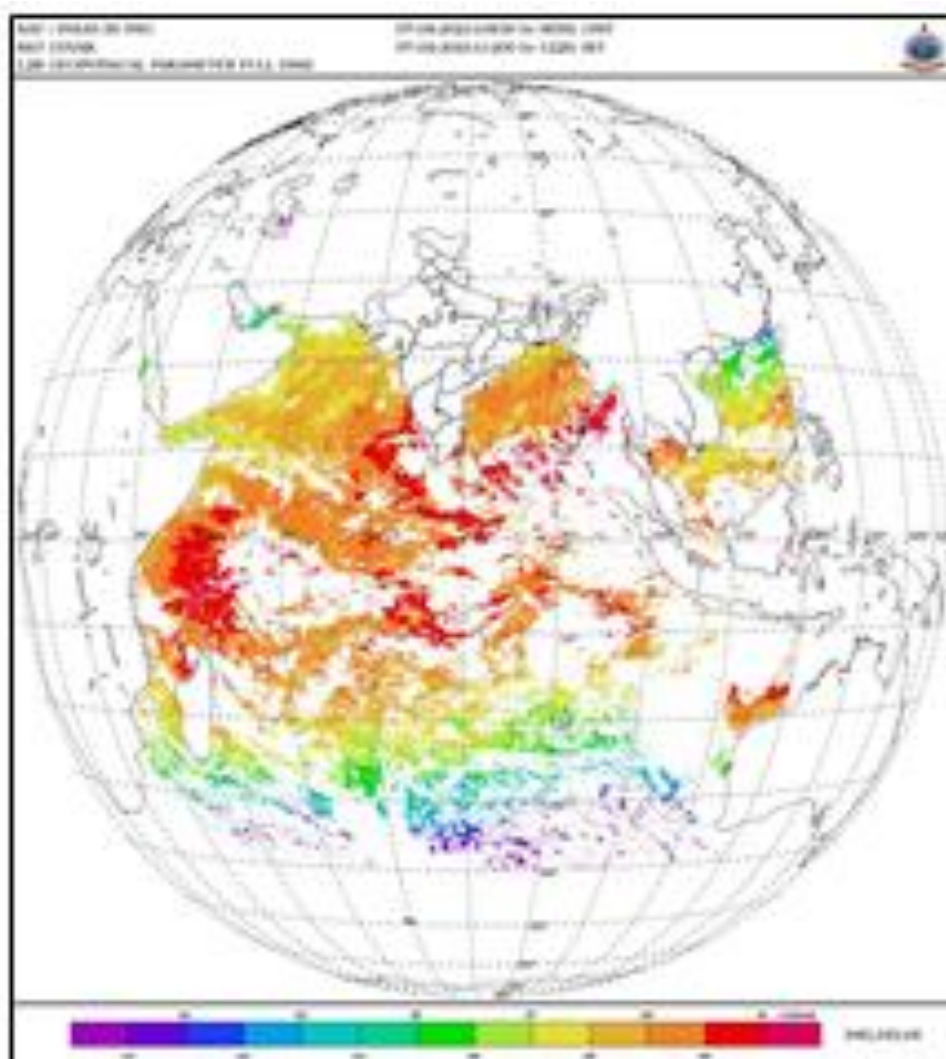
- 1.Jammu & Kashmir
- 2.Ladakh
- 3.Himachal Pradesh
- 4.Uttarakhand
- 5.Sikkim
- 6.Arunachal Pradesh

This product is being used to identify the fresh snow, melting snow area and potential vulnerability area of landslide/flash flood in mountain region



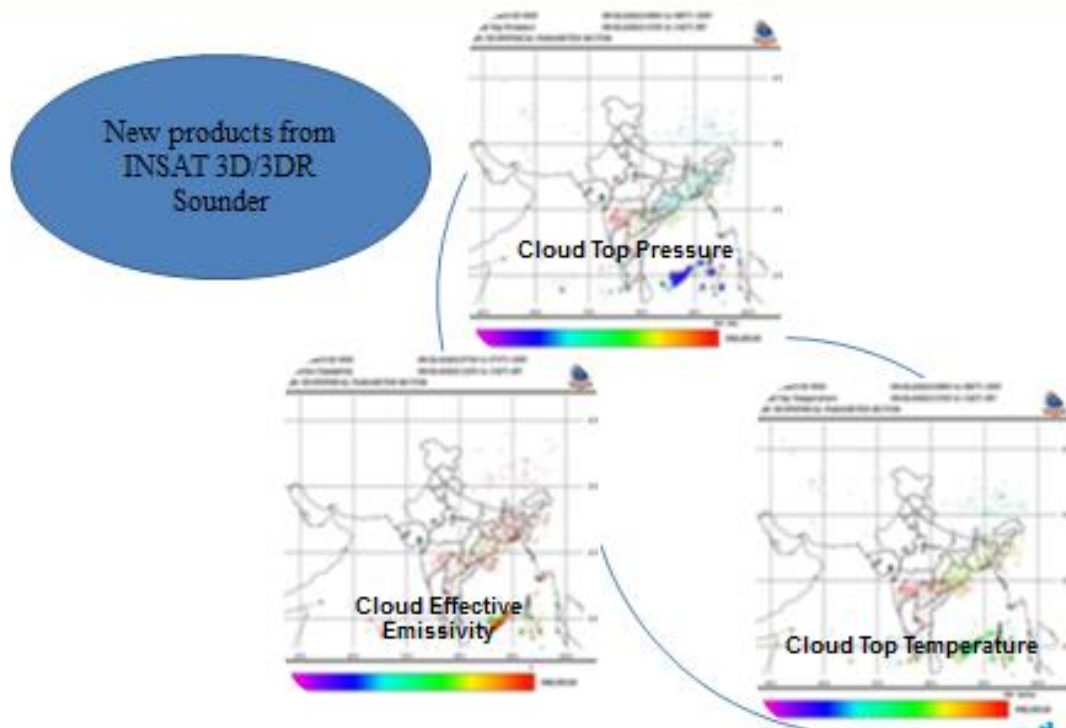
Implementation of New Algorithm of SST

Operational Implementation of 1D-Var based physical retrieval algorithms for SST has reduced the RMSE from ~0.9K to ~0.6K in both INSAT-3D & 3DR. The Biases of ~0.3K is largely due to the bulk-skin temperature differences. A new algorithm has been developed for SST retrieval from INSAT 3D/3DR Imager based on 1DVAR approach. There has been significant improvement in the 1DVar SST in comparison to NLSST because it uses accurate prior SST information as the first guess. The new algorithm shows far superior accuracy in terms of diurnal and seasonal biases.



4.2 Sounder products

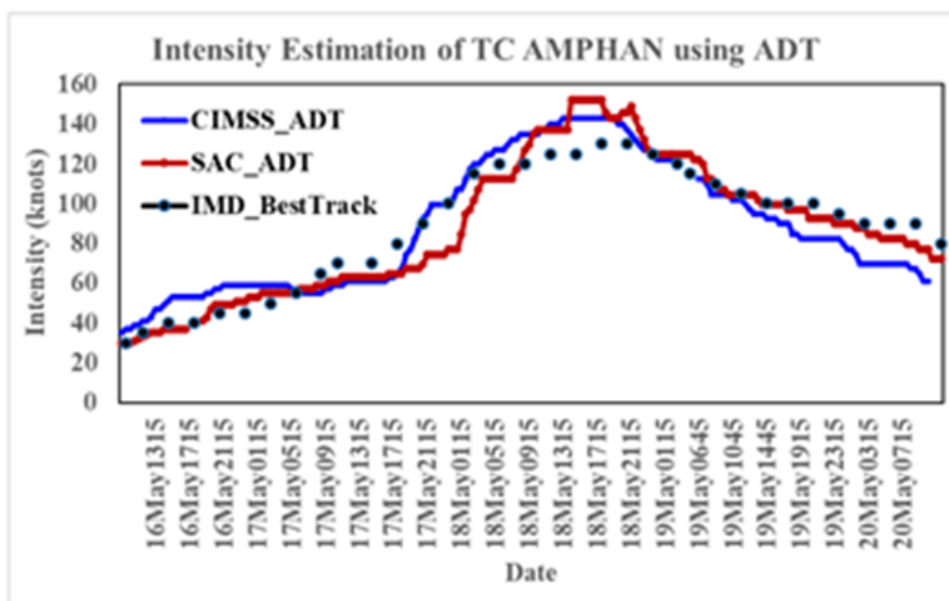
Product	Temporal Resolution	Horizontal Resolution	Format	Domain	Unit
Cloud Top Pressure	Sector-A (hourly)	50 x50 km	HDF/JPEG	Indian Land/Ocean	Milibar
Cloud Top Temperature	Sector-A (hourly)	50 x50 km	HDF/JPEG	Indian Land/Ocean	Kelvin
Cloud Effective Emissivity	Sector-A (hourly)	At each pixel level	HDF/JPEG	Indian Land/Ocean	Unit-less (0 ~1)

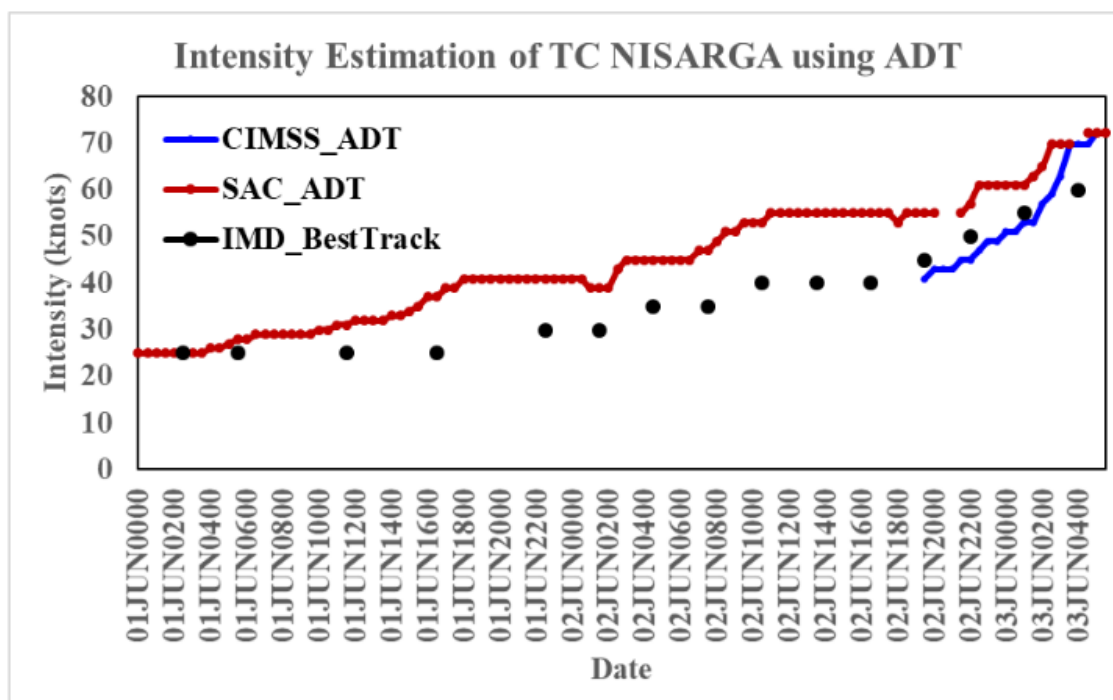


Implementation OF ADT IN MMDRPS:

Recently, new Advanced Dvorak Techniques (ADT-8.2) is implemented in MMDPRS using INSAT 3D & 3DR imager data and tested on an experimental basis of two cyclones- Amphan and Nisarga.

Implementation of ADT in MMDPRS using INSAT 3D & 3DR imager data and tested on a experimental basis of two cyclones- Amphan and Nisarga.

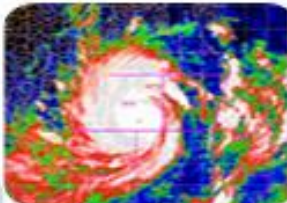
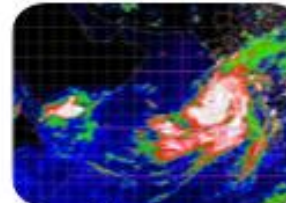
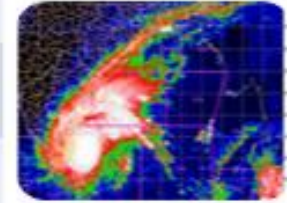
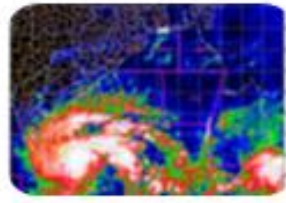




Rapid scans Conducted since CGMS-48

Rapid scan (every ~4.5 minute) facility has been successfully executed for monitoring the tropical cyclones as well as severe weather activity depending upon the operational requirements. This facility is easily programmable with the help of Indian Space Research Organization (ISRO) support and made available to the forecasters. The following rapid scans has been conducted during the period since CGMS-48.

Rapid SCAN during Cyclone events over North Indian Ocean

S.N o	Name of Cyclone	Duration	No of processed rapid scans		
1	Amphan	15th MAY 2020-21st MAY 2020	1598		
2	Nisarga	31st MAY 2020- 04th JUN 2020	972		
3	Nivar (Bay of Bengal) & Gati (Arabian Sea)	23rd NOV 2020- 26th NOV 2020	785		
4	Burevi	01st DEC 2020- 04th DEC 2020	863		

4.3 Dissemination

All the channels, specialized Images and Products Images being disseminated through dedicated webpages

- (i) <http://satellite.imd.gov.in/insat.htm>
- (ii) <http://satmet.imd.gov.in/insat3d.htm>

These Webpages are user name & password protected. International Meteorological services, National Government Agency and Research Institutions dealing with forecasting disaster management and research work can obtain the username and password information from virendra61.singh@imd.gov.in with the conditions that these will not be further shared with others. For general users, limited satellites Images are disseminated through

<https://mausam.imd.gov.in/>

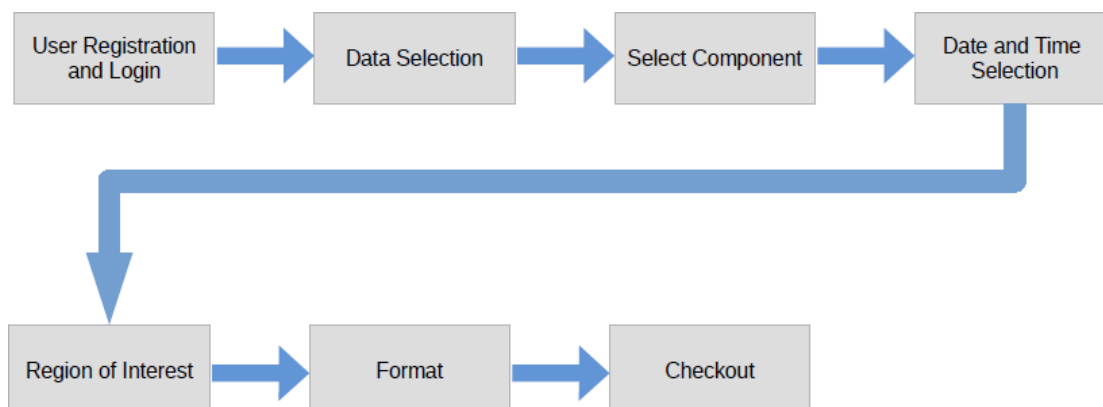
Real-time Analysis of Product and Information Dissemination (RAPID):

RAPID introduces Next Generation Weather Data Access & Advanced Visualization Application that touches the life of common man in one or other way ranging from severe weather monitoring to various sectoral applications like agriculture, tourism, sports etc. For example, we can assess the fog over railway tracks and surface transportation highways, aviation, navigation & a pilot can monitor the location, intensity & movement of cumulonimbus clouds enroute. This tool is operationally sustained by National Satellite Meteorological Centre (IMD), New Delhi. This tool is hosted at <http://www.rapid.imd.gov.in/>.

User guide for operating this tool is available on http://satellite.imd.gov.in/desc/RAPID_User_Guide.pdf. In addition, RAPID Beta Version is also in the final stage of implementation which will have the provision to visualize the NWP, radar, in-situ observational data on a real time basis overlaid on satellite data with georeferencing information & compatible to mobile users

4.4 Data Supply Service (DSS)

The MMDRPS has dedicated Web based Data supply System (DSS) in redundant mode to cater web-based data dissemination requirements in near real time basis to various users (both local and remote global) based on data dissemination policy of IMD. Web- DDS has user registration/authentication mechanism based on data dissemination policy of IMD, Metadata generation for data search; Data search & order with a facility to handle band, format, Area & temporal selection options ; Standing order ; User Administration (Add, Edit, Delete) ; User Order processing system; Data order workflow monitoring; Report generation & Data download history based on satellite/sensor & duration; Satellite, sensor parameters, Data products & metadata management (Add, Edit, Delete), The web based-DSS is in advanced stage of implementation and potential users will be informed.

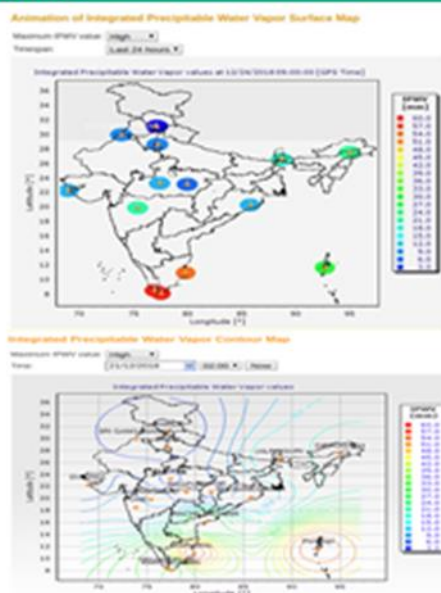


MD GNSS Network:

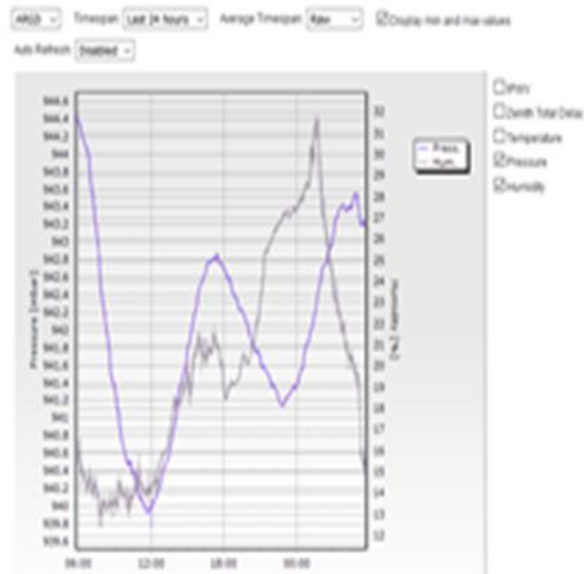
To monitor Ground based real time Integrated Precipitable Water Vapour (IPWV), IMD installed 25 GNSS all over India as Indian Global Navigation and Satellite System (GNSS) which is operationally used in day to day weather forecasting and monitoring the convective development. The real time GNSS IPWV estimated from IMD network is available in the public domain as <http://gnss.imd.gov.in/TrimblePivotWeb/>. In this web analysis, tools are available to plot real time, daily, weekly and monthly data with maximum and minimum values.

IMD installed 25 GNSS all over India and streaming data near real-time and processing in the network.

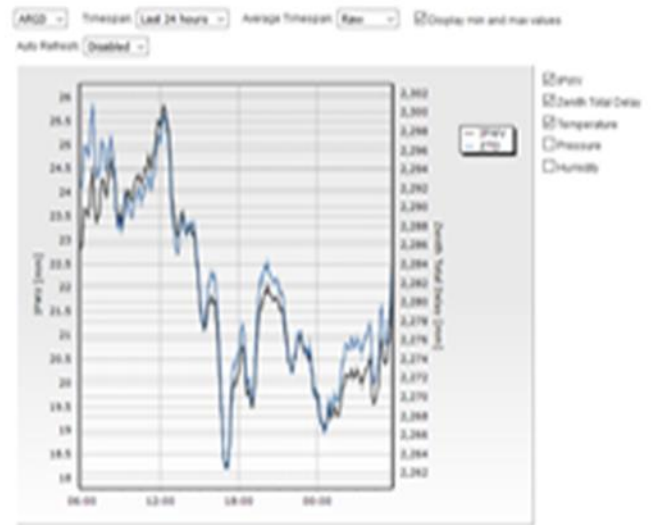
S.No.	Station Code	Stations Name	Latitude	Longitude	Ellipsoid Height (m)
1	JPR	JHUPUR	26.02	75.02	335.37
2	RPR	RANPUR	21.21	81.06	246.56
3	TRIM	TRIMANORUM	8.51	76.96	-18.44
4	KRNL	KARNAL	10.91	79.84	-79.07
5	KYKM	KANAKPUR	8.08	77.55	-49.23
6	NPTM	NALCHURPATNAM	16.18	81.15	-81.07
7	ITNG	ITANAGAR	27.10	93.03	86.50
8	DVPR	DIVAPUR	25.88	93.77	114.78
9	DBGH	DIBRUGARH	27.48	95.02	95.76
10	JPGI	JALPAIGURI	26.55	88.71	37.41
11	SHLA	SHILAI	21.10	77.17	2021.58
12	SRNR	SARNAGAR	33.97	74.79	1631.64
13	RNIN	RANICHOR	30.31	78.41	1930.54
14	DVAX	DIVAKA	22.24	68.96	-40.12
15	GOPR	GOPALPUR	19.30	84.88	-15.94
16	JBPUR	JABALPUR	23.10	79.39	388.09
17	GRRP	GORAKHPUR	26.74	83.40	22.19
18	SOGN	SRI GANGA NAGAR	28.92	73.89	132.17
19	DELI	DELHI	28.59	77.22	168.06
20	PUNE	PUNE	18.54	73.84	487.72
21	BHPL	BHOPAL	23.24	77.42	476.22
22	NAGR	NAGPUR	21.09	79.06	259.57
23	BHNR	BHUBANESHWAR	20.25	85.82	-16.72
24	PANM	PANAJI	15.49	73.83	-23.04
25	AROD	AURANGABAD	19.87	75.39	526.13



Station per Atmospheric Condition



Station per Atmospheric Condition



5. Future Missions:

GISAT-1 and INSAT-3DS geostationary satellites are the future missions to be launched. The GISAT -1 is expected to be launched in 3rd quarter 2021 and INSAT-3DS in 3rd quarter 2022.